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Reference No. 15670

Mr. Kevin Adler
United States Environmental Protection Agency
Region V
77 West Jackson Boulevard
Chicago, Illinois 60604-3590

US EPA RECORDS CENTER REGION 5
399184

Dear Mr. Adler:

Re: Waukegan Manufactured Gas Coke Plan
SAP Revision

Please find enclosed a revision to Section 5.0, Operation of Pilot Units of the Sampling and Analysis Plan, *Waukegan Manufactured Gas and Coke Plant.*

The revision is intended to optimize E/R Unit Operation to ensure the most useful results for both the chemical mass removal and tracer capture aspects of the operation. The first two weeks of the operation will be dedicated to the measurement of mass removal. During this time the re-injection system will be operated in a balanced flow configuration (equal rates at all locations) to simplify the understanding of mass removal. After two weeks the injection flow will be reconfigured with approximately 0.056 gpm (212 ml/m) of the flow introduced on the upgradient side and approximately 0.244 gpm (924 ml/m) on the downgradient side and the bromide tracer injected into RW2. This flow configuration is intended to reduce the longest flow paths for the bromide tracer and encourage bromide capture in a shorter time to ensure that a high percentage of capture is achieved while the system is operating.

Supplemental sample collection and optional analysis of the supplemental samples is included in both the chemical mass removal and tracer phases of operation. This is intended to ensure that samples are available to monitor water quality changes should these changes occur in a short time frame.

We are still trying to complete the pilot test this fall and consequently would appreciate your earliest possible response.

Yours truly,

CONESTOGA-ROVERS & ASSOCIATES

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# 5.0 OPERATION OF PILOT UNITS

## 5.1 OPERATION OVERVIEW

There will be two pilot units operated during the Pilot Project. These pilot units are designated the Extraction Unit (E-Unit) and the Extraction/Reinjection Unit (E/R Unit). Groundwater will be extracted from each of these pilot units during the Pilot Project. The extracted water from both pilot test cells will be temporarily stored in four 20,000-gallon equalization tanks. Simultaneous groundwater injection and extraction will be performed in the E/R Unit. The Pilot Project will also include groundwater sampling for chemical analyses and a bromide tracer study in the E/R Unit. Specific information concerning the operation of each of the pilot units is provided in this section.

## 5.2 E/R UNIT OPERATION

The E/R Unit will consist of three extraction wells, six reinjection wells, two monitoring well nests, and one single monitoring well (see Figure 4.1). The E/R Unit will be operated for 28 to 42 days (four to six weeks). The E/R Unit will be operated in two phases. During Phase I, the E/R Unit will be pumped at a constant low-flow rate of approximately 0.9 gallons per minute (gpm) (3,407 milliliters per minute (ml/m)), 0.3 gpm/1,114 ml/m from each extraction well) for a period of two weeks. Contemporaneously with groundwater extraction, tap water will be injected into the reinjection wells at a rate of 0.9 gpm (3,407 ml/m). This operation is intended to optimize conditions for evaluating mass removed from the aquifer under balanced reinjection conditions. After two weeks, Phase II will begin and the reinjection flow will be reconfigured to optimize the recovery of bromide tracer. During Phase II, flow rates will be used to simulate the effect of creating a downgradient hydraulic barrier against the regional hydraulic gradient. The extraction rate specified at each extraction well remains at 0.3 gpm (1,114 ml/m) per well. The injection rate specified at the upgradient injection wells will be reduced to approximately 0.056 gpm (212 ml/m) and the injection rate specified at the downgradient injection wells will be increased to approximately 0.244 gpm (924 ml/m).

### 5.2.1 GROUNDWATER EXTRACTION

The extraction wells will be pumped at a constant low-flow combined rate of approximately 0.9 gpm (i.e., 0.3 gpm [1,114 ml/m] from each extraction well). The extraction wells will be pumped using peristaltic pumps and long-life tubing that

discharge through in-line flow meters. Peristaltic pumps will be Masterflex LS® or similar variable-speed, modular drive pumps, equipped with up to two modular drives per controller, capable of sustained flow rates within the desired range.

Each discharge line will be equipped with a direct-reading inline flow meter (Gilmont® Model 03230-14, or similar) capable of reading liquid flows in the range of 20 ml/m to 1,500 ml/m ($5.3 \times 10^{-3}$ to 0.48 gpm). The accuracy of the in-line flow meters will be verified with bucket and stopwatch measurements. Discharge water will be directed to an intermediate storage tank where it will then be pumped to the 20,000-gallon storage tanks.

An enclosure will be constructed in close proximity to the E/R Unit to house the peristaltic pumps, controllers and flow meters. This enclosure will serve to protect this equipment during inclement weather. Figure 5.1 depicts the E/R Unit groundwater extraction system layout.

### 5.2.2 GROUNDWATER REINJECTION

Tap water will be injected into each of the six reinjection wells that comprise the E/R Unit. During Phase I tap water injection will be at a rate of approximately 0.15 gpm (569 ml/m) (0.9 gpm/3,407 ml/m total injection rate). Reinjection water will be staged on Site in a 1,500-gallon capacity tank that will be filled daily with tap water from a nearby source. Tap water will be pumped into each reinjection well using peristaltic pumps, long-life tubing and in-line flow meters as described in section 5.2.1. Since the purpose of Phase I is to evaluate contaminant mass removal, no tracer study will be conducted in Phase I. Groundwater samples will be collected and analyzed by the project laboratory to evaluate concentration trends for the compounds and elements of interest.

During Phase II tap water will be injected into the three downgradient reinjection wells (east side) at a rate of approximately 0.244 gpm /924 ml/min. Tap water will be injected into the three upgradient reinjection wells (west side) at a rate of approximately 0.056 gpm/212 ml/min. Phase II will operate for at least two weeks and possibly up to four weeks. The primary objective during Phase II is to obtain data concerning groundwater flow within the E/R Unit. Therefore, the bromide tracer will be injected immediately prior to startup of Phase II and sampling and analysis for bromide will be conducted. Groundwater samples will also be collected and analyzed for other compounds and elements of interest.

An enclosure will be constructed in close proximity to the E/R Unit to house peristaltic pumps, controllers and flow meters. This enclosure will serve to protect this equipment during inclement weather. Figure 5.2 depicts the E/R Unit groundwater injection system layout.

### 5.2.3 TRACER TEST

A bromide tracer test will be conducted during the Phase II portion of the Pilot Project program at the E/R Unit. A bromide tracer test will not be conducted at the E Unit location. The use of an anionic tracer such as bromide is considered appropriate for this project for two reasons. First, bromide is considered a "conservative" tracer (one which travels at nearly the same velocity as groundwater). Second, bromide is not expected to be present in the groundwater at any appreciable concentration. In order to evaluate the natural bromide concentrations prior to the tracer test, bromide analyses will be performed prior to the startup of the E/R unit at the tracer test injection well, the extraction wells.

The bromide tracer will be injected immediately prior to the startup of the the Phase II E/R Unit Operation. The bromide will be added to the tap water injected into the central reinjection well that is closest to Monitoring Well Nest No. 1 (reinjection well RW-2 shown in Figure 4.1). The bromide tracer will be introduced to RW-2 using the following procedure.

i) The bromide tracer consisting of approximately 1,180 grams of potassium bromide will be mixed with 1.8 Liters of deionized water This bromide tracer solution will be prepared by the project laboratory and delivered to the Site in solution ready for injection.

ii) Prior to injecting the bromide tracer, the depth to water will be measured in injection well RW-2. The water level will be measured to the nearest 0.01 foot using a calibrated electronic water-level meter. The depth to water will be recorded in the field log.

iii) The bromide tracer solution will be injected into the center, upgradient reinjection well (RW-2) immediately prior to (i.e. no sooner than 2 hours before) the initiation of Phase II of the Pilot Test in the E/R Unit operation.

iv) The bromide tracer will be injected into RW-2 using a peristaltic pump at a flow rate not exceeding 100 ml/min. The injection tube will be slowly moved up and down through the screened interval of RW-2 to allow mixing and a more equal distribution of tracer in the screened interval.

v) Immediately following injection of the tracer solution, a depth-to-water level reading will be recorded as described in Item ii). Water levels will be obtained periodically until the change in hydraulic head measured at RW-2 is 10 percent or less of the maximum change in hydraulic head recorded immediately following injection of the tracer solution.

vi) Following a 30-minute equilibration period, a groundwater sample will be collected from RW-2 for bromide analysis to obtain the initial concentration of the tracer in the reinjection well. Purging of RW-2 will not be conducted prior to collection of this sample to minimize removal of tracer from the well.

### 5.2.4 E/R UNIT MONITORING

The groundwater monitoring wells in both of the monitoring well nests installed in the E/R Unit will be sampled at regular intervals during operation of the E/R Unit. Sampling of the water purged from each extraction well of the E/R Unit also will be conducted three times per week. Water levels within the E/R unit will be monitored daily.

Water samples will be collected at the frequencies and for the analytes summarized in Table 4.1. During the first week of E/R Unit Operation a supplemental set of the samples defined on Table 4.1 will be collected approximately 12 hours after the originally scheduled sample collection. These samples will be held until the results of the original samples are received. The supplemental samples may be analyzed to provide better definition of contaminant concentration trends during operation of the E/R Unit. The original sample results will likely be available 14 to 21 days after sample collection. Testing of the supplemental samples for cyanide and thiocyanate will not be performed since neither of these parameters are considered to be significant in evaluating the mass removal operational results and the allowable holding times are likely to be exceeded.

Additional samples will also be collected from the WN-1 well nest on Day 8 and Day 10 to be analyzed if the contaminant reduction front requires better definition based on data received from the original samples. Pilot Project sampling protocols are summarized in Section 5.4.

Bromide monitoring will begin when the reinjection flow rates are changed to the Phase II asymmetric configuration. Monitoring will be conducted in accordance with the frequency identified in Table 4.1. During the first week of tracer monitoring a supplemental set of samples will be collected approximately 12 hours after the originally scheduled sample collection. These samples will be held until the results of the original

samples are received. The supplemental samples may be analyzed to provide better definition of the time rate of change of the bromide concentration profile. CRA will determine which supplemental samples to analyze based on bromide results from the original sample collection.

## 5.3 E UNIT OPERATION

The E Unit will consist of one extraction well and one monitoring well nest (see Figure 4.2). This unit will be operated under both steady state and pulse conditions, with up to three different extraction rates. The E Unit will undergo an intermittent extraction schedule with the pump on for 7 days and then off for 7 days. Four cycles are contemplated for the pilot testing. The extraction rate from the E Unit will be reduced with each successive pumping cycle, starting at 0.8 gpm/3,028 ml/m and ending at 0.2 gpm/757 ml/m. These flow rates may be adjusted prior to the startup of the Pilot Project depending upon Site conditions. A bromide tracer test will not be conducted at the E-Unit location.

### 5.3.1 GROUNDWATER EXTRACTION

The E Unit will be operated on the schedule defined in Section 5.2 of the Work Plan. This schedule consists of four 7-day extraction cycles, each of which is followed by a 7-day off cycle. Groundwater will be pumped at different rates during each successive extraction cycle. The first extraction cycle will consist of groundwater extraction at a rate of approximately 0.8 gpm (3,028 ml/m). The pumping rate during each of the three successive extraction cycles will be reduced by 0.2 gpm (757 ml/m) (i.e., 0.6 gpm (2,271 ml/m) during the second extraction cycle, 0.4 gpm (1,514 ml/m) during the third extraction cycle and 0.2 gpm (757 ml/m) during the fourth and final cycle). The extraction well will be pumped with a peristaltic pump using new long-life tubing discharged through an in-line flow meter. The in-line flow meter readings will be confirmed with measured bucket and stopwatch measurements. Water discharge will be to an intermediate storage tank that will be periodically pumped to large storage tanks in a cycle based on sump level.

Peristaltic pumps will be Masterflex LS® or similar variable-speed, modular drive pumps, equipped with up to two modular drives per controller, capable of sustained flow rates in the desired range. Each discharge line will be equipped with a direct-reading inline flow meter (Gilmont® Model 03230-15, or similar) capable of reading liquid flows in the range of 60 ml/min to 4,100 ml/min ($1.5 \times 10^{-2}$ to 1.1 gpm).

An enclosure will be constructed in close proximity to the E Unit to house the peristaltic pumps, controllers and flow meter. This enclosure will serve to protect this equipment during inclement weather. Figure 4.1 depicts the E Unit groundwater extraction system layout.